

subject, the list extends to forty pages, and includes the titles of 700 serials, every serial's name being followed by initials indicating some library or libraries in London, Cambridge, Oxford, Dublin, Edinburgh, or Glasgow where the serial is to be seen. This list, like the index which it precedes, is an immense boon to mathematicians. All honour to those concerned in its preparation, and may the other volumes soon follow!

What now remains, in order to satisfy the reasonable demands of students of mathematics, is the preparation of a one-page supplement making the list complete up to the present day. There may be differences of opinion as to what such a supplement ought to include. My original proposal to the London Mathematical Society in 1904 was to take as a guide the list of journals published by the council of the International Catalogue, and to the extent of one subject Prof. Armstrong's ideal would thus be attained. A more thorough course would be to associate with this list the corresponding lists which form the bases of the *Jahrbuch über die Fortschritte der Mathematik* and the *Revue semestrielle des Publications mathématiques*. Doing this, I find that our supplement, to be exhaustive, would need to include between thirty and forty entries instead of four-and-twenty; as, however, a number of these would concern journals of a very elementary character, the most prudent course at the outset might be to select only those that are included in all the three lists. The number thus reached would be a dozen, and the following are their names:—*American Mathematical Monthly*, *L'Intermédiaire des Mathématiciens*, *Revue de Mathématiques spéciales*, *Zeitschrift f. math. u. naturw. Unterricht*, *Abhandl. zur Geschichte d. math. Wiss.*, *Mathematikais Phys. Lapok*, *Periodico de matematiche* . . . , *Supplemento al Periodico* . . . , *Il Pitagora*, *Boll. di Bibl. e Storia delle sci. mat.*, *Tōkyō sugaku Butsurigaku Kwai Kiji*, *Proceedings of the Intern. Math. Congress*. Some even of these may not be very important, but surely so long as mathematicians are referred to them by the three standard annuals above mentioned it is eminently desirable that one should know where they can be consulted. Libraries, therefore, which possess sets of them should make themselves known at such a centre as the office of the International Catalogue, where possibly a suitable opportunity might present itself for placing the information at the disposal of the public. THOS. MUIR.

Cape Town, S.A., September 1.

Research Work on Natural Indigo.

My attention has been directed to a review of the report on indigo research work at Leeds University, recently made by Mr. Bloxam and others to the Government of India, which appeared in your issue of July 30. In the course of this review Prof. Meldola directs attention to the contention, which has been made by Mr. Bloxam, that, by means of new and improved methods of analysis, he has shown that there is yet scope for considerable improvement in the process of indigo manufacture. Prof. Meldola believes that a good case has been made out, and severely criticises the planters, and those who have advised them, for having neglected to take advantage of the possibilities which have been indicated by Mr. Bloxam's work, since he considers that therein lies the sole hope of the salvation of their industry.

As representing the planting community of Bihar, I feel bound to say a word in our defence and in that of our advisers. We cannot agree with Prof. Meldola that the only hope of the survival of our industry lies in a realisation of the possibilities which Mr. Bloxam believes to exist in the improvement of our process of manufacture. This process has, indeed, been considerably improved in recent years, and, thanks to this, to changes in our agricultural practices, and to the substitution of the Java for the Sumatran plant, we are now in a position to turn out our indigo at half its former cost, and we have every reason to hope that, with a few seasons of favourable climatic conditions, we shall be able to compete with the synthetic product at the lowest price at which it is likely to be able to be produced. There is also, as Prof. Meldola points out, a biological side to our problem, and we

anticipate that investigation from this aspect, which is yet in its infancy, will ultimately lead to considerable further benefit.

But it is nevertheless totally unjustifiable to describe our attitude towards Mr. Bloxam's work as a hostile one. It is perhaps true that we delayed calling in scientific aid to our industry too long, but investigations directed towards the improvement of indigo manufacture have now been in progress in India for ten years, and as a result of these investigations and by the aid of the new methods which have been introduced, our scientific advisers now tell us that nothing further can be done in improving the main processes. As practical business men we are inclined to accept this verdict rather than the opposed one, *not* because it mitigates our "past neglect," for surely it would not do so even if no improvement on our original process had been found possible (which is far from being the case), but because it seems to us more probable that investigators on the spot, who have been daily handling the fresh plant and the products of manufacture for a term of years, are more likely to be in a position to form a correct opinion than those who have dealt with preserved material for a comparatively short period. Further, it would seem that no motive other than an honest conviction could influence those who declare that their work has reached a conclusion.

We are, of course, totally unable to judge of the scientific arguments which have been advanced on either side in the recent controversy, but it is doing the gravest injustice to those who have advised us to imply, even remotely, that they have chosen to disregard the researches at Leeds lest they should disprove their own contentions. Far from having "deliberately brushed aside" the conclusions drawn by Mr. Bloxam and his colleagues, our advisers have devoted a great deal of time to close examination of the evidence whereon these conclusions are based. They have satisfied themselves that this evidence is erroneous, and continued investigations of the crucial points at issue have only served to confirm their original views. Nevertheless, they have repeatedly impressed upon us the enormous benefit which might accrue to our industry even if Mr. Bloxam's contentions were only partially correct and became realisable in practice, and they have urged us to use every effort to obtain an entirely independent opinion in the matter for this reason, and in spite of their settled conviction that such independent opinion is bound to confirm their own. It is solely owing to this urging on their part that we have taken steps to do this. T. R. FILGALT.

(General Secretary, Bihar Planters' Association.)

Mozufferpore, August 26.

I CAN assure the secretary of the Bihar Planters' Association that the comments upon their neglect of scientific method when they were first brought into competition with synthetic indigo which I felt bound to make were prompted solely in the interests of the native industry. It is practically conceded in the foregoing communication that there has been such neglect, and that the practical outcome of the revision of their processes has been the halving of the cost of production of the natural product in the course of a few years. This is satisfactory so far as it goes, but the main issue is still left very doubtful. In spite of the reduction of the cost of production by one-half, it appears that they are still in India at the mercy of climatic conditions, and even then, supposing these to be favourable for a few seasons, they have only "every reason to hope" that they will be able to compete with their coal-tar rival. Those who have at heart the welfare of our Indian Empire will cordially endorse the wish that their hope may be realised, but the point at issue between the report to the Indian Government and the Planters' Association is really whether finality has been reached in the way of improvement. According to the statement of the secretary, they have been advised that no further improvement in the "main processes" is possible. The results of the application of the newer methods of analysis indicate clearly enough that there is more indigotin in the plants than has hitherto been suspected. The advisers to the association certainly do "brush aside" this work

done at Leeds if they authorise the secretary to state "they have satisfied themselves that this evidence is erroneous." Those who in common with myself have looked critically and, I may say, quite impartially into the evidence have come to the conclusion that the analytical methods are quite dependable. Others will no doubt corroborate this statement. After the publication of the report the Planters' Association held a meeting, at which they passed a resolution expressing confidence in, and practically endorsing the opinion of, their own advisers, in face of the new evidence offered from the Leeds laboratory. I gathered this information from a report of the meeting in one of the Indian papers, which was forwarded to me at the time. This attitude, which may fairly be described as one of hostility, would have been stiffened by the above letter were it not therein admitted that the "biological side" of the problem is still in its infancy, and that further development in this direction is anticipated. Also it is conceded that "an entirely independent opinion" in the matter (? of the manufacturing processes) is to be obtained. Thus all the contentions of those who felt the ignominy of this great Indian industry "taking its whipping in a crouching attitude" are likely to be met, and our best wishes are, it is needless to say, with the planters. If they are, by the inexorable laws of nature, beaten in the long run, it will at any rate redound to their credit that they did not succumb without a good fight.

There is one point in the foregoing letter which appears of considerable importance, and to which I should like to take the present opportunity of directing attention. The evidence of the advisers to the association is accepted because it appears that they are on the spot and dealing with the fresh plant, while the Leeds chemists have been investigating "preserved material." Now if the Leeds results by the isatin method are correct—and I repeat that I see no reason to doubt them—it follows that "preservation" leads to an increased development of indican. May not this hint be worth following up practically? In thanking the secretary of the association for his communication, I should like, in conclusion, to repeat what I said during the discussion before the Society of Chemical Industry last autumn. The results given by the newer methods of analysis may be unrealisable in practice; it does not follow that because a certain percentage of indican is present in an *Indigofera* leaf the corresponding quantity of indigotin, or anything approaching that quantity, can be got out of it in the factory. All that is contended is that at the present juncture the indications furnished by a scientific quantitative method render it imperative that every resource should be strained to save the native industry. Further developments will be anxiously waited for in this country.

R. MELDOLA.

I ENTIRELY agree with the opinion expressed by Prof. Meldola in his article, entitled "A Contribution to the Indigo Question," which recently appeared in *NATURE* (p. 296), that the case had "at one period assumed a polemical aspect most detrimental to the real cause at issue," and I write this with no desire to discuss the responsibility for this regrettable state of affairs, or to revive it. My object is to record some results recently obtained by Mr. Briggs and myself, which we had not intended publishing, but which may prove of interest in the light of Prof. Meldola's article.

Anhydrous indican was prepared according to the method of Perkin and Bloxam (*Journ. Chem. Soc.*, vol. xci., p. 1715); its melting point was, as stated by these authors, 176–178°. A gram of this substance was dissolved in 500 c.c. of water. Two 100 c.c. samples were withdrawn from this solution, and analysed by the isatin method of Orchardson, Wood, and Bloxam (*Journ. Soc. Chem. Ind.*, vol. xxvi., pp. 8 and 1178), and two by the persulphate method of Bergtheil and Briggs (*Journ. Soc. Chem. Ind.*, vol. xxv., p. 734, and vol. xxvi., p. 1173). This was repeated three times with two distinct preparations of indican. The following results, expressed as the amount of indigotin (in grams) to be derived from 100 c.c. of the solutions, were obtained. The figures are means of the duplicate experiments, which agreed very closely.

	Isatin method		Persulphate method	Theory
i.	0.0841	...	0.0840	0.0888
ii.	0.0855	...	0.0845	
iii.	0.0852	...	0.0845	

The indirubin obtained by the isatin method was analysed by titration with titanium chloride (Knecht) in each case, and found to be 98 per cent. pure (average of six samples); the titanium chloride solution was standardised on pure iron, and also on pure indigotin obtained by sublimation under reduced pressure (Bloxam).

The indican employed was evidently not pure, the analyses indicating a purity of 94.6 per cent. in the first case, and 95.6 per cent. in the second and third, but this degree of purity is sufficiently high for the purpose of comparing the methods. The comparisons indicate that almost identical results are obtained, the mean difference being 0.7 per cent.

Another point which these figures seem to establish is the accuracy of our method of determining indigotin (at any rate, so far as the factor for the relationship between indigotin and permanganate is concerned), for it is extremely improbable that, were an error involved in this method, it would be so exactly counterbalanced by errors in the other direction in the precipitation of indigotin by persulphate as to bring the results into such close approximation with those obtained by the isatin method.

If these two points are conceded, then the main grounds on which the contention is based, that "the older methods have overestimated the indigotin content of the dried cake, and have underestimated the amount of indican in the leaf," disappear. C. BERGTHEIL.

Sirsiah, September 2.

An Alleged Excretion of Toxic Substances by Plant Roots.

SINCE the communication entitled "An Alleged Excretion of Toxic Substances by Plant Roots" appeared in *NATURE* (August 27, p. 402), it seems desirable to state the exact position taken by the Bureau of Soils on the question of deleterious substances in soils and root excretions.

Abundant evidence has already been presented to the effect that substances deleterious to plant growth do exist in many soils, and are mainly responsible for the infertility therein observed,¹ and toxic substances, to wit, picoline carboxylic acid and dihydroxystearic acid, have actually been isolated and identified. In carefully controlled experiments these toxic conditions have been shown to arise as the result of the continuous growth of the same sort of plants upon the soil. In addition, it has been shown that plants like wheat excrete substances which set up toxic conditions in the medium. Toxic conditions may also arise from the presence of the decomposition products of vegetable matter in the soil. Indeed, it has been shown that very many substances naturally occurring in plants are toxic in quite small amounts. When plants containing these substances are incorporated with the soil, they may play an important rôle as soil constituents.

Regarding the criteria of growth, it may be said that not transpiration alone, as implied in the article referred to, but several standards of growth were employed in the investigations of this bureau, viz. weight of green tops, dry weight, transpiration, turgidity and colour of roots, chemotropic response of the roots. All these criteria are employed in determining the physiological effect of substances on plants, but no one is regarded as absolute.

The statements made in Bulletin No. 48 of this bureau were based, as was said in the note referred to, upon many thousands of pot experiments, and the conclusions seem justified by the results of that work. It is obviously possible to choose figures from any table which are apparently discordant. A comparison of the paraffin pot method of testing soils with the results of continuous plot experiments in this country has shown good agreement.²

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¹ Bulletins Nos. 28, 36, 40 and 41 Bureau of Soils; Rept. Hawaii Agr. Exp. Sta., 1906, p. 37; *Journ. Biol. Chem.*, iii., Proc. 38 (1907); *Journ. Amer. Chem. Soc.*, xxx., 1295 (1908); *Science*, xxvii., 190, 295, 328, 329 (1908).

² Bull. 109, Rhode Island Agr. Exp. Sta.